December 2004

Improving the Quality of Drug Management

of Saskatchewan Seniors in Long-Term Care

Research Report

HEALTH QUALITY COUNCIL

105-02469/

Recommended Citation Format:

L Clatney, L Gander, BTB Chan, N Sidhu, H Xie, P Cascagnette. Improving the Quality of Drug Management of Saskatchewan Seniors in Long-Term Care, Research Report. Saskatoon: Health Quality Council. December 2004.

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Research Report: ISBN 1-897155-04-2

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Introduction

Selecting a combination of medications for the elderly that optimizes disease management while minimizing the risk of adverse effects is a major challenge. Seniors are more likely to have multiple medical problems and hence be exposed to multiple medications, which increase the risk of drug interactions. The elderly are more susceptible to altered drug metabolism, excretion and other physiological responses.[1,2,3] These changes may increase sensitivity to drugs and the risk of adverse effects. These types of medication-related problems may lead to more visits to health professionals, additional tests, more medication, hospitalizations, and even death.[3,4,5,6]

The literature suggests that medication management in the elderly is an area of the health care system where there is room for improvement. Past studies raise concern about drug therapy in long-term care (LTC) facilities, where patients are exposed to multiple drugs. One Ontario study found potentially inappropriate prescriptions in 18 per cent of residents at one site.[7] Another Ontario study found that 21 per cent of elderly LTC residents received a prescription for at least one potentially inappropriate drug.[8] One recent Canadian study examining prescriptions of neuroleptics found that the use of these drugs increased from 17 per cent prior to admission to a special care home to 24 per cent one year after admission.[9] Neuroleptics are associated with an increased risk of falls, neuroleptic-induced Parkinsonism and strokes.[9]

This study examines whether similar issues regarding quality of care exist among seniors in Saskatchewan's LTC facilities. The study examines process measures of quality, which describe whether a particular activity took place that may contribute, positively or negatively, to quality. Process measures are sensitive to differences in the quality of care.[10] They are relatively easy to interpret provided there is an evidence-based link between the given process and resident outcome (e.g., mortality, falls). We present three classes of indicators of quality of care for consideration:

1. **"Recommended"** quality indicators examine whether a particular drug was dispensed in a clinical situation where there is good evidence of benefit.
2. **"Cautionary"** indicators refer to the use of drugs with important side effects in the elderly. Cautionary situations also include instances where two drugs with such side effects were given, or where the recommended maximum dose in the elderly was exceeded. There may be reasonable indications for using these drugs. However, such situations could be the focus of periodic medication reviews to ensure the benefits outweigh risks.
3. **"High-risk, potentially avoidable"** drugs have a high risk of serious adverse side effects in the elderly, and have a clearly defined, safer alternative. We cannot state categorically that these drugs are inappropriate, as there may be rare instances where they are the last resort (e.g. an allergy to the alternative). Medications in this category correspond to the Beers criteria, an internationally recognized list of medications to avoid in the elderly.[11]

Methods

Development of prescribing indicators

We formed an expert advisory committee to develop indicators for this study *(see Appendix 1)*. This group consisted of ten individuals with varied experience from acute, long-term, and community-practice settings, and with expertise in pharmacology and geriatric medicine. The committee reviewed indicators used in other jurisdictions to assess medication appropriateness in the elderly[12,13,14,11,1,15] and made modifications where needed, due to differences in Saskatchewan formularies or drug guidelines.[16]

Specific indicators

We describe here the rationale for each indicator. A complete technical definition of indicators used in this study appears in *Appendix 2*.

Indicator 1: Polypharmacy

The elderly usually have more medical conditions and hence tend to use more drugs. However, the greater the number of different drugs prescribed, the higher the risk of an adverse drug reaction.[16]

Indicator type: Cautionary

Indicator 2a: Use of NSAID / coxibs

Non-steroidal anti-inflammatory drugs (NSAIDs) are frequently prescribed for the pain and inflammation from arthritis and related disorders.[17,18] NSAIDs, however, are associated with an increased risk of gastrointestinal (GI) morbidity, due primarily to bleeding, and mortality. This risk increases with age and the number of comorbidities.[16,17,19]

Indicator type: Cautionary

Indicator 2b: Use of 2 or more NSAID / coxibs

Use of more than one type of NSAID concurrently on a chronic basis may lead to an even greater risk of serious GI side effects.[20]

Indicator type: Cautionary

Indicator 2c: Use of NSAID/coxibs with a gastroprotective agent

If NSAID therapy must be prescribed, then there are several ways to reduce the risk of GI complications. One option is to prescribe misoprostol, which protects the stomach lining. Alternatively, medications to suppress acid may be given, such as histamine type-2 receptor antagonists - H_2RAs (cimetidine, famotidine, nizatidine, ranitidine) or proton pump inhibitors - PPIs (lansoprazole, omeprazole, pantoprazole). Another option is to use a Cox-II inhibitor, or coxib (celecoxib, and rofecoxib), which is a more selective type of NSAID with a lower risk of GI side effects, in lieu of the combination of a non-selective NSAID plus misoprostol, H_2RA or PPI. There is a growing trend toward the use of a gastroprotective agent in addition to a coxib in high-risk patients but the clinical benefits have not yet been fully evaluated.[19] Although we did not examine dosage information for H_2RAs, we know from the literature that standard doses of H_2RAs are generally considered not as effective as misoprostol or PPIs in reducing the risk of endoscopically identified NSAID-induced ulcers.[19]

Current practice guidelines and quality measurement tools identify the use of a gastroprotective drug when an NSAID is prescribed to individuals at high risk for GI bleeding as a desirable measure of quality.[21,23,24] Some jurisdictions have now changed their guidelines to recommend the prescription of gastroprotective medication to all elderly patients who chronically use NSAIDs.[16,21] There is no consensus as to which regimen is least likely to cause serious GI complications [22,19] Therefore, we constructed our indicator as the proportion of patients who were on an NSAID who were either on misoprostol, an H_2RA, a PPI, or whose NSAID was a coxib.

Indicator type: Recommended

Indicator 2d: Use of NSAID/coxibs excluding ASA, with a gastroprotective agent

Because low–dose ASA has a lower risk of GI side effects than other NSAIDs,[23] we also calculated this indicator after excluding those residents whose only NSAID dispensed was ASA 325 enteric-coated tablets and whose average daily dose for this drug was less than or equal to 400mg/day. Some elderly individuals with few medical conditions may be considered to be at low risk for a GI bleed. Therefore, the case for recommending a GI protectant with an NSAID, excluding ASA 325 mg, may be stronger than in the indicator above when we include all NSAIDs in the calculation.

Indicator type: Recommended

Rofecoxib and celecoxib were granted automatic EDS through the on-line computer system for individuals 65 years of age or greater in July 2001 (mid-point of the study year). Previously, a request needed to be submitted to the Saskatchewan drug plan for EDS. Rofecoxib was withdrawn from the market in September 2004 due to concerns that the drug increases the risk of heart attack and stroke.[25]

Indicator 3a: Drugs with anticholinergic effects

The Drug Quality Assessment Committee and Saskatchewan Formulary Committee have developed a reference list of drugs with moderate to high anticholinergic effects.[24] Such drugs block cholinergic receptors of the parasympathetic nervous system, causing reactions such as confusion, delirium, memory impairment, reduced sensitivity, dry mouth and constipation.[25] The elderly are more sensitive to these effects.[26]

Indicator type: Cautionary

Indicator 3b: Multiple drugs with anticholinergic effects

The risk of an adverse event increases with the number of anticholinergic drugs dispensed.[26]

Indicator type: Cautionary

Indicator 4a: Benzodiazepine use

Benzodiazepine use has been shown to increase the risk of falls in the elderly.[27,28,29,30,31] Furthermore, falls are associated with significant increases in mortality and morbidity.[30,28,29,27] Reduction of benzodiazepines in general may be an appropriate fall reducing intervention.[30] Until recently, short-acting agents were thought to be a safer choice than long-acting agents. New research is emerging, however, that concludes no significant reduction in the number of falls when using a short, versus a long-acting, benzodiazepine.[30,28,29,32,33]

Clobazam was not included in these analyses, as less than five long-term care residents were chronically dispensed this drug, and its main indication for use is to control epileptic seizures.[34]

Indicator type: Cautionary

Indicator 4b: Multiple benzodiazepine use

This indicator describes the proportion of chronic benzodiazepine users who were prescribed two or more different benzodiazepines within the year.

Indicator type: Cautionary

Indicator 4c: Exceeding maximum dose of benzodiazepine

This indicator examines the percentage of residents who were dispensed an average daily dose above the maximum recommended daily dose for the elderly. This indicator is one component of the Beers criteria (see below). For dosages not explicitly listed by Beers, a maximum allowable dose was set equivalent to 3 mg of lorazepam, using the WHO Defined Daily Dose (DDD) index (see technical appendix for maximum recommended doses).

Indicator type: High-risk, potentially avoidable

Indicator 5a: Use of antipsychotic medications

Antipsychotic medications are used most commonly for controlling behavioural symptoms in the elderly, such as aggression, agitation, and paranoia.[35,9] However, they are also associated with an increased risk of falls, neuroleptic-induced Parkinsonism, and adverse cerebrovascular events.[9] Some antipsychotics have also been reported to be associated with weight gain and new onset diabetes.[36]

Indicator type: Cautionary

Indicator 5b: Use of multiple antipsychotic medications

This indicator measures the percentage of residents who were prescribed two or more antipsychotics. Generally, combining similar antipsychotics is not recommended, even in "difficult" patients, as there is no data on the safety or efficacy of prescribing multiple antipsychotics.[35]

Indicator type: Cautionary

Indicator 5c: Exceeding the maximum dose of antipsychotic medications

For atypical antipsychotics (clozapine, olanzapine, quetiapine, risperidone) plus haloperidol, we also calculated the percentage of residents on these drugs receiving an average daily dose above the maximum recommended level (as per RxFiles).[25]

Indicator type: Cautionary

Indicator 6a: Use of multiple antidepressants

Antidepressants refer to several different classes of drugs that improve symptoms of depression. These drugs may also be used, often at lower doses, for other indications such as pain control or sleep disturbances. Use of antidepressants is generally well tolerated in the elderly, with the exception of those drugs appearing in the anticholinergic list or Beers criteria. Hence, their use in themselves does not warrant them to be treated as a cautionary indicator. However, we do examine multiple antidepressant use as an indicator. There may be instances where this is clinically warranted; for example, a patient may be on one antidepressant for depression and a second medication, such as trazodone at a low dose, for sleep disturbances. Nonetheless, multiple antidepressants increase the potential for significant drug interactions and are generally not recommended due to the lack of scientific evidence supporting their use in older adults.[37]

Indicator type: Cautionary

Indicator 7: Use of multiple psychotropic medications

Caution is advised when consuming multiple psychotropics as the combination may increase risk of CNS, falls, and other adverse effects.[38,39]

Indicator type: Cautionary

Indicator 8: Use of Beers criteria drugs

Beers and his colleagues have developed a list of medications that are either ineffective in the elderly or put them at an unnecessarily high risk when safer alternatives are available. This list, also known as the "Beers criteria", has been used extensively in previous research and has recently been updated.[14] Even a single prescription for one of these drugs could increase the likelihood of an adverse event for an elderly resident. [11,14] The advisory committee made minor modifications to the Beers list, because many of the drugs listed are either not available, or used too infrequently in Saskatchewan's long-term care population to be meaningful.

Indicator type: High-risk, potentially avoidable

Indicator 8b: Use of multiple Beers criteria drugs

This indicator notes the number of residents dispensed more than one drug on the Beers list.

Indicator type: High-risk, potentially avoidable

Definition of concepts for indicator construction

Chronic Use:

The primary focus of our study is on chronic drug use, as opposed to sporadic drug use in LTC facilities. For all medications (with the exception of those listed in Beers updated criteria of drugs to avoid in the elderly), the following conditions must have been met for the drug to be included in the study: there must have been a minimum of three prescriptions written for the drug within the 2001 calendar year, and, there must have been a minimum of 100 pills dispensed during this same year.

Duplication of therapy:

A resident was deemed to have a duplication of therapy if he or she had: two or more different generic drug prescriptions dispensed from the same drug class within a period of 35 days; and, at least one refill on a minimum of two drugs meeting the above criteria during the time period of 90 days.

Average daily dose:

The Prescription Drug Plan Database information is limited to the dose and amount dispensed, but does not include the intended frequency of the prescription. For example, if 30 pills are dispensed, it is not known whether this prescription should last 15, 30 or 60 days, because the pill frequency could have been two, one, or one-half tablets per day, respectively. For each prescription in the drug database where information on average daily dose was needed, we inferred the average dose as follows. We examined the previous two prescriptions dispensed for the same medication and calculated the average pill frequency over those two prescriptions (equal to the total number of pills dispensed in those two

prescriptions, divided by the number of days elapsed between the prescription and the earlier of the previous two prescriptions). For each case, we multiplied the pill frequency by the strength of the pill to calculate the dose. We then looked backwards and examined the previous two prescriptions, and inferred the dosage frequency per day.

Data sources

We used Saskatchewan's Institutional Supportive Care System database to identify all LTC residents during calendar year 2001. We linked this cohort anonymously to the Person Registry System (PRS) database using unique scrambled health card numbers. The PRS file was used to identify patient age, sex, regional health authority of residence, Registered Indian status and death information. This file was also used to determine if a patient had valid Saskatchewan health insurance coverage. We then merged these data with the Saskatchewan Prescription Drug Plan database to identify residents who were dispensed any drug therapy under the SK Health Formulary between January 1, 2001 and December 31, 2001.

Cohort selection

As in previous studies, we allowed for at least a 90-day period for each resident during which prescription drug data were not analyzed.[8] This offered health care providers an opportunity to modify a resident's drug therapy upon admission to a LTC facility. We then examined drug data for each resident for the next 365 days, excluding any residents who had a total length of stay of less than 455 days. Residents under age 65 in 2001 were excluded because the elderly were our focus. Registered Indians and other individuals whose prescription drugs are covered federally were also excluded because their drug use is not captured in Saskatchewan's prescription drug database. Finally, we excluded residents from the study if they had a hospitalization of ≥ 35 consecutive days during the study period, or a discharge from long-term care facility for ≥ 35 consecutive days during the study period, because an absence from long-term care for greater than this time period would disrupt medication ordering patterns.

Statistical analysis

Data extraction and analyses were completed using SAS Version 8.2 software. Logistic regression analyses were used to test for differences between our indicators and patient demographics of age and sex (see Appendix 3). If age was a significant predictor in the logistic regression, we age-adjusted, in addition to adjusting for sex, in our subsequent small-area rate variation (SARV) analyses. We used the chi-square statistic with one degree of freedom, which was calculated by squaring the difference between the crude number of procedures/year and the indirect expected count, which was then divided by the indirect expected count. The p-value was generated from a chi-square test with 1 degree of freedom using the crude counts and indirect expected counts for each RHA. SARV analyses were used to test for statistically significant differences on indicators between the provincial and RHA rates.

Results

Cohort description

Our cohort included 5,209 individuals aged 65 and older who met our study criteria (see Table 1 for a breakdown between RHAs). Of these, 72% were female. The mean age of our sample was 85 years (SD 7.84) and 10% were 65 to 74 years of age.

Table 1: Long-term care residents in study by Regional Health Authority

Regional Health Authority	Frequency (N)	Percent of total sample (%)
Sun Country	441	8.5
Five Hills	312	6.0
Cypress	325	6.2
Regina Qu'Appelle	1,095	21.0
Sunrise	585	11.2
Saskatoon	1,210	23.0
Heartland	315	6.0
Kelsey Trail	282	5.4
Prince Albert Parkland	324	6.2
Prairie North	307	5.9
Northern Saskatchewan	13	0.2

Data source: Saskatchewan Institutional Supportive Care System database, 2001

Polypharmacy

During the study period, individuals in the cohort were dispensed an average of 8.8 different drugs, as classified by different generic drug names. This number is likely an underestimate, as over-the-counter drugs not reimbursed by Saskatchewan Health are absent in the drug databases (with the exception of some OTC drugs, which are covered provincially for Plan 3 residents* - about 15% of our sample). When we applied the chronic use condition, we found that the residents in our sample were chronically dispensed an average of 5.2 different drugs during the study period.

* Plan 3 beneficiaries are entitled to receive all Formulary drugs and certain non-Formulary drugs at no charge. Plan 3 beneficiaries are residents receiving supplementary assistance who live in Special-Care Homes licensed under The Housing and Special-Care Homes Act, Approved Homes licensed under The Mental Health Act, wards of the province and inmates of provincial jails.[9]

Table/Figure 1: Polypharmacy - Frequency table of number of drugs dispensed chronically to elderly LTC residents in Saskatchewan, 2001

Number of drugs	Frequency (N)	Percent (%)
< 6 drugs	1,617	31.04
6-10 drugs	1,960	37.63
11-15 drugs	1,026	19.70
16-25 drugs	542	10.41
> 25 drugs	64	1.23

Data source: Saskatchewan Institutional Supportive Care System database, 2001

NSAID use

One in three LTC residents in Saskatchewan were chronically dispensed an NSAID (Table 2). Of those, 12 per cent were chronically dispensed two drugs from this class, while less than 1 per cent were dispensed more than two different NSAIDs. Of those chronically dispensed an NSAID, 64% were either chronically dispensed a gastroprotective agent with a non-selective NSAID, or were given a coxib. There were 488 residents who were chronically dispensed only enteric-coated acetylsalicylic acid (ASA) 325 mg at average daily doses of less than or equal to 400 mg/day. When we excluded patients on ASA and no other NSAID, the percentage of residents receiving GI protection increased to 79 per cent.

Table 2: Age/sex adjusted dispensing rates for NSAID/ coxib use and concomitant GI protection among elderly long-term care residents, Saskatchewan 2001

Regional Health Authority	% of LTC residents dispensed an NSAID	% of residents on an NSAID who were dispensed ≥ 2 NSAIDs	% of residents on an NSAID who had GI protective measure taken[a]	% of residents on an NSAID (excluding ASA) who had GI protective measure dispensed[a]
Saskatchewan	32.8	13.0	63.6	79.3
Sun Country	35.1	14.8	61.9	79.0
Five Hills	29.6	8.7	63.9	78.7
Cypress	35.0	13.3	71.7	85.1
Regina Qu'Appelle	30.9	14.9	64.9	80.2
Sunrise	38.7*	17.5*	67.4	82.9
Saskatoon	29.4*	9.6	58.2	72.8
Heartland	38.8	11.5	61.2	79.6
Kelsey Trail	33.1	10.8	57.0	75.2
Prince Albert Parkland	26.5*	13.9	67.4	79.3
Prairie North	41.1*	12.5	67.4	85.2
Northern Saskatchewan	56.1	--	--	--

* < 0.05, ** < 0.01; *** < 0.001

Data source: Saskatchewan Institutional Supportive Care System database, 2001

-- information suppressed due to cell sizes of less than five in either the numerator or denominator

[a] because coxibs are commonly used as a substitute for the concomitant use of a non-selective NSAID and gastroprotective agent, coxibs (celecoxib and rofecoxib) were included in the numerator and denominator. Diclofenac sodium/misoprostol was also included in both the numerator and denominator as it is an NSAID/GI protectant combo.

[b] per cent of total NSAID/coxib users

The choice of NSAID and method of GI protection varied. Of the 1,711 residents dispensed NSAIDs, 64% were dispensed a non-selective NSAID, 28% celecoxib and 19% rofecoxib. (These proportions do not add to 100% because some patients were on multiple NSAIDs.) Of the 1,089 LTC residents who had some form of GI protection, 44% were dispensed celecoxib, 30% rofecoxib, 34% an H2RA, 12% a PPI, and 1% misoprostol.

There were some regional variations between RHAs in use of NSAIDs, but no significant difference between RHAs in the use of GI protective measures.

Anticholinergic medications

Almost one in four LTC residents chronically received drugs with moderate to high anticholinergic properties (Table 3). Of these, one in six were on two or more anticholinergic drugs. Two RHAs, Sun Country and Prairie North, had significantly higher use of anticholinergic drugs.

Table 3: Age/sex adjusted dispensing rates of drugs with moderate-high anticholinergic effects among elderly LTC residents in Saskatchewan, 2001

Regional Health Authority	% of LTC residents chronically dispensed anticholinergics	% of LTC residents on anticholinergics dispensed ≥ 2 anticholinergics
Saskatchewan	22.8	16.0
Sun Country	28.6*	18.4
Five Hills	19.4	22.4
Cypress	27.2	21.7
Regina Qu'Appelle	20.2	15.7
Sunrise	21.2	15.2
Saskatoon	20.5	14.8
Heartland	23.7	8.2
Kelsey Trail	21.9	18.3
Prince Albert Parkland	20.6	14.9
Prairie North	34.0***	17.3
Northern Saskatchewan	--	--

* < 0.05; ** < 0.01; *** < 0.001

Data source: Saskatchewan Institutional Supportive Care System database, 2001

Table 4: Most frequently dispensed anticholinergics among elderly LTC residents in Saskatchewan, 2001

Anticholinergic drug	Among LTC residents on anticholinergics, % dispensed selected drugs
amitriptyline	22.0
oxybutynin Chloride	17.0
benztropine Mesylate	12.2
olanzapine	8.6
methotrimeprazine	8.0
nortriptyline	6.1
dimenhydrinate	5.9
doxepin	4.9
loxapine	4.8
chlorpromazine	4.1

Benzodiazepines

Among elderly LTC residents, more than one-fifth were chronically dispensed a benzodiazepine (Table 5). Of those chronic users, one in nine were dispensed two or more concurrently, and almost one in four were chronically dispensed a dosage above the maximum recommended amount for an elderly person. Prince Albert Parkland had a significantly lower rate of multiple benzodiazepine use.

Table 5: Age/sex adjusted dispensing rates of benzodiazepines among elderly LTC residents in Saskatchewan, 2001

Regional Health Authority	% of residents chronically dispensed a benzodiazepine	% of benzodiazepine users dispensed ≥ 2 benzodiazepines[a]	% of benzodiazepine users dispensed dose exceeding recommended maximum
Saskatchewan	20.9	10.5	23.1
Sun Country	24.8	14.9	26.0
Five Hills	22.1	9.5	20.0
Cypress	19.9	13.9	22.4
Regina Qu'Appelle	18.8	10.3	25.2
Sunrise	24.0	11.7	24.4
Saskatoon	19.6	10.9	19.3
Heartland	21.2	8.0	12.7
Kelsey Trail	20.5	10.4	20.9
Prince Albert Parkland	20.8	0.0**	28.8
Prairie North	24.0	9.8	32.6
Northern Saskatchewan	--	--	--

* < 0.05; ** < 0.01; *** < 0.001

[a] per cent of total benzodiazepine users

Data source: Saskatchewan Institutional Supportive Care System database, 2001

The most frequently dispensed benzodiazepines were lorazepam (47%), temazepam (27%), and clonazepam (11%). The drugs most often dispensed at doses exceeding the recommended maximum were temazepam and triazolam (70% and 56% of users respectively). The most frequent combinations of multiple benzodiazepines were: lorazepam and temazepam (n=48), lorazepam and clonazepam (11), lorazepam and alprazolam (7), and alprazolam and temazepam (7).

Among the 1,091 patients on benzodiazepines, 92.9% were on short-acting formulations, 7.4% on long-acting, and 1.7% on ultra-short acting (triazolam only).

Antipsychotic use

Almost one in three LTC residents were chronically dispensed an antipsychotic. Of those, one in nine were taking 2 or more antipsychotics at the same time (Table 6). Prairie North had a significantly higher rate of antipsychotic use and rate of multiple antipsychotic use. The most frequently dispensed antipsychotics were risperidone (63%), thioridazine (11%), haloperidol (10%), and olanzapine (6%). The most common combinations of multiple antipsychotics were: methotrimeprazine and risperidone (n=30), risperidone and haloperidol (23), and risperidone and thioridazine (17).

Table 6: Age/sex adjusted dispensing rates of antipsychotics among elderly LTC residents, 2001

Regional Health Authority	% of residents dispensed antipsychotics	% of residents dispensed antipsychotics who received ≥ 2 antipsychotics[a]
Saskatchewan	30.6	10.9
Sun Country	32.1	13.3
Five Hills	24.5	8.5
Cypress	29.7	21.1*
Regina Qu'Appelle	29.1	10.0
Sunrise	29.8	8.9
Saskatoon	32.0	8.3
Heartland	30.9	5.4
Kelsey Trail	32.1	5.8
Prince Albert Parkland	27.3	11.1
Prairie North	37.6*	21.7***
Northern Saskatchewan	--	--

* < 0.05; ** < 0.01; *** < 0.001

[a] per cent of total antipsychotic users

Data source: Saskatchewan Institutional Supportive Care System database, 2001

Table 7 shows the percentage of residents dispensed an average daily dose above the recommended dosage in the elderly.

Table 7: Percentage above recommended daily dose

	Max dose (mg)	Frequency above	# of residents dispensed drug	Per cent
clozapine	50	<5	<5	--
haloperidol	2	75	160	46.9
olanzapine	10	26	102	25.5
quetiapine	150	13	50	26.0
risperidone	2	172	1008	17.1

Data source: Saskatchewan Institutional Supportive Care System database, 2001

Antidepressants

Among LTC residents, 28% were dispensed antidepressants, and there were no significant differences between RHAs (Table 8). One in 11 patients on antidepressants received two or more concurrently.

Table 8: Age/sex adjusted dispensing rates of antidepressants among elderly LTC residents, 2001

Regional Health Authority	% of LTC residents on antidepressants who were dispensed ≥ 2 antidepressants
Saskatchewan	8.6
Sun Country	14.3*
Five Hills	8.5
Cypress	9.3
Regina Qu'Appelle	9.4
Sunrise	7.8
Saskatoon	6.1
Heartland	7.5
Kelsey Trail	--
Prince Albert Parkland	10.6
Prairie North	8.0
Northern Saskatchewan	--

* < 0.05; ** < 0.01; *** < 0.001
Data source: Saskatchewan Institutional Supportive Care System database, 2001

The most frequently dispensed antidepressants were paroxetine (21.5%), amitriptyline (17.9%), sertraline (13.8%), venlafaxine (10.2%), and trazodone (8.9%). In most instances, amitriptyline and trazodone were prescribed in low doses typically used for indications other than depression. Of the 261 amitriptyline users, 82% were on a dose under 50 mg; of the 130 trazodone users, 77% were on a dose under 100 mg.

Psychotropic use - summary measure

Among elderly LTC residents, 27.9% were dispensed drugs from more than two different classes of psychotropic medications. These classes are benzodiazepines, antipsychotics, and antidepressants. Table 9 describes the frequency of different combinations of classes.

Table 9: Use of drugs from multiple psychotropic classes among elderly LTC residents in Saskatchewan, 2001

	antipsychotic + benzodiazepine + antidepressant	antipsychotic + benzodiazepine	benzodiazepine + antidepressant	antipsychotic + antidepressant
LTC residents (N)	157	415	408	474
LTC residents (%) of 5,209	3.0	8.0	7.8	9.1

Data source: Saskatchewan Institutional Supportive Care System database, 2001

High-risk, potentially avoidable drugs (Beers criteria)

Among elderly LTC residents, 28% received at least one high-risk, potentially avoidable drug from the Beers list, on a chronic basis (Table 10). This number increased to 33% when the chronic drug use condition was removed (Table 11). Saskatoon RHA consistently had a significantly lower user rate of these drugs. Of those chronically dispensed drugs on the Beers list, approximately 16% were chronically dispensed two or more.

Table 10: Age/sex adjusted chronic use dispensing rates of Beers list drugs among elderly LTC residents in Saskatchewan, 2001

Regional Health Authority	% of total LTC residents dispensed Beers drugs	% of LTC residents dispensed Beers drugs who were dispensed ≥ 2 Beers drugs
Saskatchewan	27.5	15.8
Sun Country	35.2**	12.9
Five Hills	29.4	12.3
Cypress	32.4	19.0
Regina Qu'Appelle	26.6	15.7
Sunrise	29.3	18.1
Saskatoon	24.1*	16.1
Heartland	27.5	10.4
Kelsey Trail	26.2	28.2**
Prince Albert Parkland	24.9	6.9
Prairie North	27.6	18.1
Northern Saskatchewan	--	--

* < 0.05; ** < 0.01; *** < 0.001

Patients had to be given, in 2001, at least three prescriptions and 100 pills for a drug in the Beers list of drugs which have a high risk of adverse effects are potentially avoidable, in order to be counted as being dispensed a Beers drug.

Data source: Saskatchewan Institutional Supportive Care System database, 2001

Table 11: Age/sex adjusted dispensing rates of Beers list drugs among elderly LTC residents in Saskatchewan, 2001

Regional Health Authority	% of total LTC residents dispensed Beers drugs	% of LTC residents dispensed Beers drugs who were dispensed ≥ 2 Beers drugs
Saskatchewan	32.8	20.3
Sun Country	40.7**	19.2
Five Hills	34.8	15.5
Cypress	39.8*	24.1
Regina Qu'Appelle	31.3	19.6
Sunrise	35.3	25.7
Saskatoon	28.0**	19.1
Heartland	33.3	16.2
Kelsey Trail	33.7	31.5*
Prince Albert Parkland	30.0	14.0
Prairie North	33.4	16.3
Northern Saskatchewan	--	--

* < 0.05; ** < 0.01; *** < 0.001

Patients had to be given, in 2001, at least one drug in the Beers list of drugs which have a high risk of adverse effects are potentially avoidable, in order to be counted as being dispensed a Beers drug.

Data source: Saskatchewan Institutional Supportive Care System database, 2001

Table12 indicates the ten most commonly dispensed Beers list drugs in Saskatchewan.

Table 12 Most frequently dispensed Beers drugs for elderly LTC residents in Saskatchewan, 2001

Beers' List Drugs	% of LTC residents dispensed Beers drugs
digoxin (above a dose of .125 mg/day)	6.3
amitriptyline	5.0
temazepam above a dose of 15 mg/day	4.0
hydroxyzine	3.7
thioridazine	3.2
fluoxetine	1.8
conjugated estrogens	1.7
doxepin	1.1
diazepam	1.1
ticlopidine	0.8

Discussion

This report offers providers of long-term care a first view of the quality of dispensing practices in Saskatchewan. It identifies some encouraging results on the use of gastroprotective measures in patients on NSAIDs, although we emphasize that no clear benchmarks exist for this indicator. It identifies areas requiring future evaluation and review, such as the instances of cautionary medications. Third, it highlights areas for improvement in the system. Over one in three patients has been prescribed at least one high-risk, potentially avoidable drug in the course of a year. Over one in four patients received at least one such drug on a chronic basis in 2001. We discuss the implications of each of these findings below.

Recommended medications

The majority of Saskatchewan's LTC residents on NSAIDs (64%) are taking some form of gastroprotection. Based on feedback from our stakeholders and our advisory group, these results are encouraging. We did not find any other studies in the literature that examined the same indicator as the one used in this study. Studies from one US and two Dutch facilities report the use of gastroprotective measures at 11%, 0% and 21% respectively. However, these studies excluded H_2RAs. When examining only misoprostol and PPIs, our data indicate dispensing rates of 13%, putting us on par with rates elsewhere. Since 2001, PPIs and misoprostol have likely increased in use, given changes to the formulary guidelines and increased evidence of their benefits. Future HQC studies will examine expanded use of these drugs. Information from medication reviews may also help in setting benchmarks for the use of these medications in the future.

When low-dose ASA was excluded, we found compliance with a gastroprotective regimen increased to 79%. The use of gastroprotection for low-dose ASA, however, is more controversial than with other NSAIDs. ASA, unlike other NSAIDs, is often given in a low-dose daily regimen for prevention of cardiovascular complications. Hence, practitioners may feel that an elderly patient, particularly one with relatively few chronic conditions, does not need gastroprotection, because that patient is not at "high risk." However, the practice guidelines do not differentiate between low-dose ASA and NSAIDs.[21,18] Low-dose ASA, compared to no ASA, has been reported to increase the risk of GI bleeding by at least two-fold.[40] Administrative data alone provide insufficient information to assess the appropriateness of gastroprotection in low-dose ASA patients. In such instances, drug reviews could periodically re-examine the need for a gastroprotective agent.

Cautionary medications

One in five LTC residents were chronically prescribed one or more benzodiazepines, and many residents were prescribed doses above the recommended maximum. These results are similar to what's been found in other jurisdictions.[41,42,43,21] Benzodiazepines increase the risk of adverse effects in the elderly, such as falls, confusion, and delirium.[30,29,27,31] These risks increase significantly with higher doses, even among long-term users.

Often, benzodiazepine use can be reduced or stopped altogether, without any noticeable effects to the resident. There are examples in the literature of where seniors' benzodiazepine use has been successfully decreased without increasing the use of other replacement drugs.[44,45] In some instances, patients admitted to LTC facilities with a prescription for a long-acting benzodiazepine are often left on this agent, even though there may be no clinical indication for the drug, due to concerns with withdrawal, physicians' perceived resident-attachment to the drug, and their belief that psychotropic medications help the elderly to remain functional.[46] There is evidence, however, that the elderly can be successfully withdrawn from benzodiazepines without any withdrawal symptoms or emergent sleep problems.[44] Some simple non-pharmacological steps to reduce dependency on benzodiazepines for insomnia include allowing appropriate sleep hours, omitting coffee after 1 pm, promoting exercise and discouraging daytime napping.[47]

This study shows that 28% of the elderly are on antidepressants. Other studies note that antidepressants tend to be underprescribed.[40] This study suggests that the usage rate of antidepressants is comparable to the prevalence rate of depression of 25-40% reported in other LTC institutions,[40] although

drugs within this class are often used for other indications such as pain or sleep disturbances. On-going drug reviews should examine whether antidepressants are being instituted where appropriate, and whether the LTC environment is contributing positively to the patient's mood.

We also identified instances where patients were dispensed multiple antipsychotic medications, doses of antipsychotics exceeding the maximum, multiple antidepressants, and multiple classes of psychotropic medications. Administrative data alone cannot determine the appropriateness of these situations. Nonetheless, periodic drug reviews could identify opportunities to reduce the use of these medications, dosages, and multiple combinations.

High-risk, potentially avoidable drugs

More than one quarter (28%) of residents were chronically dispensed high-risk, potentially avoidable drugs, as defined by the Beers criteria. A recent Ontario study found that 21 per cent of special care home residents aged 66 years and older were prescribed at least one inappropriate drug by the Beers criteria.[8] While this may not be an appropriate benchmark, it does demonstrate that lower rates of Beers drugs are feasible.

The reasons why patients are still on these drugs, despite the existence of this list for over a decade, are unclear. In many instances, cost is not an issue. For example, amitriptyline, which has strong anticholinergic and sedative properties, can be easily be substituted with nortriptyline, and both have a cost of $0.06 - $0.20 per tablet. An alternative explanation is that the drugs may have been prescribed at a time when they were the best choice, but newer, safer options have since been introduced into practice. Some providers may be unaware of the new choices. Or, the resident may have been admitted into the LTC facility already on these drugs and because the patient was clinically stable, the provider did not wish to initiate a change in management. The exact cause of why these drugs are used could be part of the information gathered in future medication reviews, so that the underlying causes for continued use of these drugs can be addressed.

Limitations

This study has several limitations:

- We could not examine *under*prescribing of medications, a documented problem elsewhere, particularly in the area of secondary disease prevention; [47]
- We had incomplete data on over-the-counter medications (e.g., uncoated ASA);
- Drug data for claims paid by the federal government (e.g. Registered Indians, veterans, and RCMP officers) were not captured;
- We report data for year 2001 and prescribing trends may have since changed;
- Information was reported at the level of the RHA and not individual LTC facilities;
- We had no data on promotional samples or prescriptions written but not dispensed; and,
- Patient adherence to therapy cannot be determined (although these last two limitations are less likely in LTC settings).

Although this study did not report on patient outcomes (e.g. falls, GI bleeds or death), indicators were based on evidence in the literature linking each process of care indicator to a measurable outcome.

Next steps

This report suggests that a key priority for quality improvement can be the reduction in use of high-risk, potentially avoidable medications in the elderly. The HQC's Quality Improvement Guide documents a number of possible strategies to accomplish this, including:

- The development of a clinical decision tool, identifying which drugs can be used in lieu of the Beers drugs;
- Provider education strategies, through Rx files, an academic detailing program, as well as other avenues; and,

- The creation of interdisciplinary teams that include the services of a consultant pharmacist at the LTC site and encourage the resident's participation.

The HQC will be working with stakeholders throughout Saskatchewan to implement these and other change strategies. The HQC will also be updating the results of this report on a regular basis so that health care providers can assess how the system is improving over time. Future studies will also examine the extent to which these prescribing concerns also exist among the elderly population living in the community.

References

1. Knight, EL and Avorn, J. Quality indicators for appropriate medication use in vulnerable elders. Annals of Internal Medicine 2001; 135(8 Pt 2):703-710.
2. Mackinnon, NJ and Hepler, CD. Preventable drug-related morbidity in older adults 1. Indicator development. Journal of Managed Care Pharmacy 2002; 8(5):365-371.
3. Higashi, T, Shekelle, PG, Solomon, DH, Knight, EL, Roth, C, Chang, JT et al. The quality of pharmacologic care for vulnerable older patients. Annals of Internal Medicine 2004; 140(9):714-720.
4. Anderson, GM, Beers, MH, and Kerluke, K. Auditing prescription practice using explicit criteria and computerized drug benefit claims data. Journal of Evaluation in Clinical Practice 1997; 3(4):283-294.
5. Gurwitz, J. Suboptimal medication use in the elderly: The tip of the iceberg. Journal of the American Medical Association 1994; 272(4):316-317.
6. Liu, GG and Christensen, DB. The continuing challenge of inappropriate prescribing in the elderly: An update of the evidence. Journal of the American Pharmaceutical Association 2002; 42(6):847-857.
7. Gill, S, Misiaszek, B, and Brymer, C. Improving prescribing in the elderly: A study in the long term care setting. Canadian Journal of Clinical Pharmacology 2001; 8(2):78-82.
8. Dhalla, IA, Anderson, GM, Mamdani, MM, Bronskill, SE, Sykora, K, and Rochon, PA. Inappropriate prescribing before and after nursing home admission. Journal of the American Geriatrics Society 2002; 50(6):995-1000.
9. Bronskill, SE, Anderson, GM, Sykora, K, Wodchis, WP, Gill, S, Shulman, KI et al. Neuroleptic drug therapy in older adults newly admitted to nursing homes: Incidence, dose, and specialist contact. Journal of the American Geriatrics Society 2004; 52(5):749-755.
10. Mant, J. Process versus outcome indicators in the assessment of quality of health care. International Journal for Quality in Health Care 2001; 13(6):475-480.
11. Fick, DM, Cooper, JW, Wade, WE, Waller, JL, Maclean, JR, and Beers, MH. Updating the Beers criteria for potentially inappropriate medication use in older adults: Results of a US consensus panel of experts. Archives of Internal Medicine 2003; 163(22):2716-2724.
12. Naugler, CT, Brymer, C, Stolee, P, and Arcese, ZA. Development and validation of an improving prescribing in the elderly tool. Canadian Journal of Clinical Pharmacology 2000; 7(2):103-107.
13. Fitzgerald, LS, Hanlon, JT, Shelton, PS, Landsman, PB, Schmader, KE, Pulliam, CC et al. Reliability of a modified medication appropriateness index in ambulatory older persons. Annals of Pharmacotherapy 1997; 31(5):643-644.
14. Wenger, NS and Shekelle, PG. Assessing care of vulnerable elders: ACOVE project overview. Annals of Internal Medicine 2001; 135(8):642-646.
15. Hanlon, JT, Schmader, K, Samsa, GP, Weinberger, M, Uttech, K, and Lewis, I. Methods for assessing the appropriateness of drug therapy. Journal of Clinical Epidemiology 1992; 45:1045-1051.
16. van Dijk, KN, Pont, LG, de Vries, CS, Franken, M, Brouwers, JR, and Jong-van den Berg, LT. Prescribing indicators for evaluating drug use in nursing homes. Annals of Pharmacotherapy 2003; 37(7-8):1136-1141.
17. Lapane, KL, Spooner, JJ, Mucha, L, and Straus, WL. Effect of nonsteroidal anti-inflammatory drug use on the rate of gastrointestinal hospitalizations among people living in long-term care. Journal of the American Geriatrics Society 2001; 49(5):577-584.
18. Saag, KG, Olivieri, JJ, Patino, F, Mikuls, TR, Allison, JJ, and MacLean, CH. Measuring quality in arthritis care: The Arthritis Foundation's quality indicator set for analgesics. Arthritis and Rheumatism 2004; 51(3):337-349.

19. CCOHTA. Gastroduodenal ulcers associated with the use of non-steroidal anti-inflammatory drugs: A systematic review of preventive pharmacological interventions. Technology Overview 2004; (12):1-16.

20. Peura, DA. Prevention of nonsteroidal anti-inflammatory drug-associated gastrointestinal symptoms and ulcer complications. American Journal of Medicine 2004; 117 Suppl 5A63S-71S.

21. van Dijk, KN. Pharmacotherapy in frail elderly: Pharmacy data as a tool for improvement. 2002; 23-113. http://www.ub.rug.nl/eldoc/dis/science/k.n.van.dijk/thesis.pdf (August 2004)

22. Mamdani, M, Juurlink, DN, Lee, DS, Rochon, PA, Kopp, A, Naglie, G et al. Cyclo-oxygenase-2 inhibitors versus non-selective non-steroidal anti-inflammatory drugs and congestive heart failure outcomes in elderly patients: A population-based cohort study. Lancet 2004; 363(9423):1751-1756.

23. Lanas, A. Cyclo-oxygenase-1/cyclo-oxygenase-2 non-selective non-steroidal anti-inflammatory drugs: Epidemiology of gastrointestinal events. Digestive and Liver Disease 2001; 33(Suppl 2):529-534.

24. Saskatchewan Health. Reference list of drugs with anticholinergic effects. Saskatchewan Health, Drug Plan and Extended Benefits Branch 2004; http://formulary.drugplan.health.gov.sk.ca (October 2004)

25. The RxFiles Academic Detailing Program. Psychotropic drugs in the elderly: Treatment considerations. Saskatoon, Saskatchewan; 2001.

26. Zubenko, G and Sunderland, T. Geriatric neuropharmacology: Why does age matter? In: Coffey E, Cummings J, editors. The American Psychiatric Press Textbook of Geriatric Neuropsychiatry.Washington, DC: American Psychiatric Press; 2000.

27. Ray, WA, Thapa, PB, and Gideon, P. Benzodiazepines and the risk of falls in nursing home residents. Journal of the American Geriatrics Society 2000; 48(6):682-685.

28. Ensrud, KE, Blackwell, TL, Mangione, CM, Bowman, PJ, Whooley, MA, Bauer, DC et al. Central nervous system-active medications and risk for falls in older women. Journal of the American Geriatrics Society 2002; 50(10):1629-1637.

29. Leipzig, RM, Cumming, RG, and Tinetti, ME. Drugs and falls in older people: a systematic review and meta-analysis: I. Psychotropic drugs. Journal of the American Geriatrics Society 1999; 47(1):30-39.

30. Guideline for the prevention of falls in older persons. American Geriatrics Society, British Geriatrics Society, and American Academy of Orthopaedic Surgeons Panel on Falls Prevention. Journal of the American Geriatrics Society 2001; 49(5):664-672.

31. Sgadari, A, Lapane, KL, Mor, V, Landi, F, Bernabei, R, and Gambassi, G. Oxidative and nonoxidative benzodiazepines and the risk of femur fracture. Journal of Clinical Psychopharmacology 2000; 20(2):234-239.

32. Wagner, AK, Zhang, F, Soumerai, SB, Walker, AM, Gurwitz, JH, Glynn, RJ et al. Benzodiazepine use and hip fractures in the elderly: Who is at greatest risk? Archives of Internal Medicine 2004; 164(14):1567-1572.

33. Wang, PS, Bohn, RL, Glynn, RJ, Mogun, H, and Avorn, J. Hazardous benzodiazepine regimens in the elderly: Effects of half-life, dosage, and duration on risk of hip fracture. American Journal of Psychiatry 2001; 158(6):892-898.

34. Canadian Pharmacists Association. Compendium of pharmaceuticals and specialties. 36th edition. Ottawa, Canada: Canadian Pharmacists Association; 2001.

35. Gravenstein, S, Beier, M, and Singer, C. Challenges in the management of psychotic symptoms in long-term care. Journal American Medical Directors Association 2003; 4(4 Suppl):H17-H20.

36. McIntyre RS, McCann SM, and Kennedy SH. Antipsychotic metabolic effects: Weight gain, diabetes mellitus, and lipid abnormalities. Canadian Journal of Psychiatry 2001; 46(3):273-281.

37. ASHP therapeutic position statement on the recognition and treatment of depression in older adults: American Society of Health-System Pharmacists. American Journal Health System Pharmacist 1998; 55(23):2514-2518.

38. Centorrino, F, Goren, J, Hennen, J, Salvatore, P, Kelleher, J, and Baldessarini, R. Multiple versus single antipsychotic agents for hospitalized psychiatric patients: Case-control study of risks versus benefits. American Journal of Psychiatry 2004; 161(4):700-706.

39. Drug Plan and Extended Benefits Branch, SH. Annual Statistical Report 2002-03. Drug Plan and Extended Benefits Branch, Saskatchewan Health 2004; http://formulary.drugplan.health.gov.sk.ca/publications/2002-2003_Annual_Report.pdf (October 2004)

40. Kelly, JP, Kaufman, DW, Jurgelon, JM, Sheehan, J, Koff, RS, and Shapiro, S. Risk of aspirin-associated major upper-gastrointestinal bleeding with enteric-coated or buffered product. Lancet 1996; 348(9039):1413-1416.

41. Avorn, J and Gurwitz, J. Drug use in the nursing home. Annals of Internal Medicine 1995; 123(3):195-204.

42. Gurwitz, JH, Field, TS, Avorn, J, McCormick, D, Jain, S, Eckler, M et al. Incidence and preventability of adverse drug events in nursing homes. American Journal of Medicine 2000; 109(2):87-94.

43. Hanlon, JT, Schmader, KE, Ruby, CM, and Weinberger, M. Suboptimal prescribing in older inpatients and outpatients. Journal of the American Geriatrics Society 2001; 49(2):200-209.

44. Curran, HV, Collins, R, Fletcher, S, Kee, SC, Woods, B, and Iliffe, S. Older adults and withdrawal from benzodiazepine hypnotics in general practice: Effects on cognitive function, sleep, mood and quality of life. Psychological Medicine 2003; 33(7):1223-1237.

45. VanHaaren, AM, Lapane, KL, and Hughes, CM. Effect of triplicate prescription policy on benzodiazepine administration in nursing home residents. Pharmacotherapy 2001; 21(10):1159-1166.

46. Damestoy, N, Collin, J, and Lalande, R. Prescribing psychotropic medication for elderly patients: Some physicians' perspectives. Canadian Medical Association Journal 1999; 161(2):143-145.

47. Golden, AG, Silverman, MA, and Preston, RA. Prescribing medications for geriatric patients in the managed care setting. American Journal of Managed Care 2000; 6(5):610-618.

Appendix 1: Advisory group

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Yvonne Shevchuk	Professor of Pharmacy and Head, Division of Pharmacy, U of S; HQC Board member

Appendix 2: Indicators

Indicator	Type	Variable Type at Individual Patient Level	Numerator for Aggregate Measure	Denominator for Aggregate Measure
Polypharmacy	Process (Cautionary)	Count	Number of different drugs (classified by generic drug name) that each long-term care resident was dispensed in 2001	All long-term care residents who met inclusion criteria for study
NSAID/coxib- use	Process (Cautionary)	Binomial	Number of residents dispensed an NSAID/coxib (chronic use)	All long-term care residents who met inclusion criteria for study
NSAID/coxib - duplication of therapy	Process (Cautionary)	Binomial	Number of residents, who, within 35 days, had 1) prescriptions dispensed for 2 or more NSAIDs/coxibs (chronic use) and 2) had at least 1 refill for each of these drugs during the duplication period of 90 days	Number of residents dispensed an NSAID/coxib (chronic use)
GI/NSAID	Process (Recommended)	Binomial	Number in denominator dispensed a GI protectant (meeting criteria for chronic use)	Number of residents dispensed an NSAID/coxib (chronic use) Note: celecoxib, diclofenac sodium/misoprostol, & refecoxib were included in numerator and denominator
GI/NSAID	Process (Recommended)	Binomial	Number in denominator dispensed a GI protectant (meeting criteria for chronic use)	Number of residents dispensed an NSAID/coxib (chronic use) excluding ASA 325mg (avg. daily dose of less than or equal to 400mg)
Anticholinergics - use	Process (Cautionary)	Binomial	Number of residents dispensed drugs with known anticholinergic properties	All long-term care residents who met inclusion criteria for study
Anticholinergics - multiple therapy	Process (Cautionary)	Binomial	Number of residents, who, within 35 days, had prescriptions dispensed for 2 or more drugs with known anticholinergic effects (chronic use) and had at least 1 refill for each of these drugs during duplication period of 90 days	Number of residents dispensed an anticholinergic drug (chronic use)
Benzodiazepine - use	Process (Cautionary)	Binomial	Number of residents dispensed benzodiazepines	All long-term care residents who met inclusion criteria for study

Indicator	Type	Variable Type at Individual Patient Level	Numerator for Aggregate Measure	Denominator for Aggregate Measure
Benzodiazepine - duplication of therapy	Process (Cautionary)	Binomial	Number of residents who, within 35 days, had prescriptions dispensed for 2 or more benzodiazepines (chronic use) and at least 1 refill for each of these drugs during duplication period of 90 days	Number of residents dispensed a benzodiazepine (chronic)
Benzodiazepine - above max. recommended dose	Process (Cautionary)	Binomial	Number of residents who are prescribed an avg. daily dose above recommended max. (chronic use)	Number of residents on each benzodiazepine (chronic use)
Antipsychotics - use	Process (Cautionary)	Binomial	Number of residents dispensed antipsychotics (chronic)	All long-term care residents who met inclusion criteria for study
Antipsychotics - above max. recommended dose	Process (Cautionary)	Binomial	Atypicals + haloperidol - number of residents who are prescribed an avg. daily dose above recommended max (Rx Files)	Number of resident on each atypical + haloperidol
Antipsychotics - duplication of therapy	Process (Cautionary)	Binomial	Number of residents, who, within 35 days, had prescriptions dispensed for 2 or more antipsychotics (chronic) and at least 1 refill for each of these drugs during duplication period of 90 days	Number of residents dispensed an antipsychotic (chronic)
Antidepressants - duplication of therapy	Process (Cautionary)	Binomial	Number of residents who, within 35 days, had prescriptions dispensed for 2 or more antidepressants (chronic use) and at least 1 refill for each of these drugs during duplication period of 90 days	Number of residents dispensed an antidepressant (chronic)
Beers criteria for drugs to avoid in elderly - use (1)	Process (High Risk, Potentially Avoidable)	Binomial	Number of residents dispensed each drug on list (by generic name) (chronic)	All long-term care residents who met inclusion criteria for study
Beers criteria for drugs to avoid in elderly - duplication of therapy (1)	Process (High Risk, Potentially Avoidable)	Binomial	Number of residents who, within 35 days, had prescriptions dispensed for 2 or more Beers drugs (chronic use) and at least 1 refill for each of these drugs during duplication period of 90 days	Number of residents dispensed a drug from Beers list (chronic)
Beers criteria for drugs to avoid in elderly - use (2)	Process (High Risk, Potentially Avoidable)	Binomial	Number of residents dispensed each drug on list (by generic name) (min 1-script rule)	All long-term care residents who met inclusion criteria for study

Indicator	Type	Variable Type at Individual Patient Level	Numerator for Aggregate Measure	Denominator for Aggregate Measure
Beers criteria for drugs to avoid in elderly - duplication of therapy (2)	Process (High Risk, Potentially Avoidable)	Binomial	Number of residents who, within 35 days, had prescriptions dispensed for 2 or more Beers drugs and at least 1 refill for each of these drugs during duplication period of 90 days	Number of residents dispensed a drug from Beers list

Appendix 3: Logistic regression results of age and sex influencing indicators, 2001

Indicator	Predictor			
	Age		Female	
NSAID/coxib - use	1.01	***	1.07	
NSAID/coxib - duplication of therapy	0.99		1.50	*
GI/NSAID	0.99		1.55	***
Anticholinergics - use	0.96	***	1.10	
Anticholinergics - duplication of therapy	0.97	***	1.16	
Benzodiazepine - use	0.98	***	1.30	**
Benzodiazepine - duplication of therapy	0.98		1.28	
Benzodiazepine - above max recommended dose	0.99		0.86	
Antipsychotics - use	0.96	***	1.04	
Antipsychotics - duplication of therapy	0.95	***	0.65	*
Antipsychotics - above recommended dose	0.93	***	0.72	*
Antidepressants - use	0.97	***	1.28	***
Antidepressants - duplication of therapy	0.97	**	1.00	
Beers criteria for drugs to avoid in elderly -chronic use	0.98	***	1.14	
Beers criteria for drugs to avoid in the elderly -chronic duplication of therapy	0.99		0.89	
Beers criteria for drugs to avoid in elderly 1- prescription use	0.98	***	1.10	
Beers criteria for drugs to avoid in elderly 1-prescription duplication of therapy	0.98	*	1.01	